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2011 Regional Applied Research Effort (RARE) Proposal - Abstract

TITLE: An epidemiologic health study of manganese (Mn) exposure in East Liverpool, Ohio

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REGIONAL SCIENCE NEED: Potential neurotoxicity from airborne Mn exposure has been a community and risk assessment concern for more than a decade in Region 5 (e.g. OH, MI). The RARE program funded a 2009-2010 Mn health study in Marietta OH near a large industrial emitter of airborne Mn, led by Rosemarie Bowler of San Francisco State University. Mt. Vernon OH, demographically similar to Marietta but without large industrial Mn emission sources, was used as the comparison community for Marietta. Initial Marietta-Mt. Vernon comparisons generally indicate a lack of major health effect differences between the two towns. Whether this extends to East Liverpool OH, an area of much higher (up to 50-fold) outdoor air Mn concentrations is the present research question of interest, and a central reason for extending the Marietta-Mt. Vernon study.

Some of the highest chronic US residential Mn inhalation exposure is likely to have occurred in East Liverpool. The proposed work is important in that either positive results (differences between East Liverpool and comparison communities) or negative results (little or no differences among communities) inform the issue of potential health effects of residential airborne Mn exposure, a recognized gap in Mn health effects literature. Both outcomes can also help inform the need for greater airborne Mn control. In addition, the present proposal addresses the USEPA Administrator's environmental justice priority: the poverty rate is higher in East Liverpool (25.2%) than in Marietta (16.9%), Mt. Vernon (15.6%), Ohio (7.8%) or the U.S. (9.2%).

SPECIFIC GOALS AND APPROACH: To evaluate whether long term (minimum 10 years) residential airborne Mn exposure can affect human health, the study will compare already-available Marietta and Mt. Vernon adult resident results with those of East Liverpool for biomarkers (blood metals), medical tests (symptoms; illnesses; Unified Parkinson's Disease Rating Scale evaluation), functional tests (mood; neuropsychological tests [e.g. working memory and attention, verbal skills, motor dexterity/strength, visual tracking speed]) and questionnaires (life style habits; work; dietary Mn). Key research questions include:

- Are blood and plasma Mn (controlled for Cd, Hg, and Pb exposure by measuring these metals in whole blood; controlled for Fe status and liver function by measuring plasma ferritin and the hepatic enzymes ALT and GGT, respectively) significantly elevated in East Liverpool adult residents vs. those in Marietta and Mt. Vernon? An additional novel

diagnostic biomarker using toenails will be used to assess longer term Mn exposure (7-10 months).

- What differences in environmental and lifestyle factors may contribute to blood and toenail Mn levels in East Liverpool residents?
- Is Mn body burden associated with altered neurological and neuropsychological function, or medical symptoms and illnesses?
- Do health outcomes (e.g. neuropsychological test results) differ among the three towns?
- Can Mn exposure-effect relationships with health and illness be shown through use of a cumulative exposure index?

EXPECTED RESULTS AND PRODUCTS: East Liverpool residents have probably been exposed to some of the highest long term outdoor air Mn concentrations in the US. Health data from this community could advance knowledge of potential effects of residential airborne Mn exposure (an issue of global, national and R5 interest) and can help evaluate the need for further pollution controls. This information would also add context to the USEPA School Air Toxics study that includes schools in both Marietta and East Liverpool. Manuscripts with results of the Marietta-Mt. Vernon work are already in preparation for submission to the professional literature, to which results from E. Liverpool would be added.

TRANSLATION, IMPLEMENTATION OR COMMUNICATION PLAN: Study results will address a long term community and USEPA R5 public health concern, i.e. whether exposure to higher residential outdoor air Mn concentrations results in detectable human health effects. Residents will be informed of the study results by the study team. This communication will serve to ensure accurate risk perception by residents. Preliminary contacts with interested community members have been made. Results could also inform the ongoing Ferroalloys Production residual risk assessment, as well as an updating of the Mn entry in USEPA's IRIS database (requested by the State of Michigan).

PROPOSED BUDGET: $100,000

PROJECT TIMELINE: Anticipated project period is May 2011 - May 2012.